



# Data Literacy

# Definition

**“Data literacy** is the ability to read, understand, create, and communicate data as information. Much like literacy as a general concept, data literacy focuses on the competencies involved in working with data.”

[https://en.wikipedia.org/wiki/Data\\_literacy](https://en.wikipedia.org/wiki/Data_literacy)



## BASIC ELEMENTS OF DATA

The data literate person knows how to distinguish between different types of data, such as categorical and numerical variables, discrete versus continuous values, and ratio or interval data fields. Beyond merely being able to identify data types, however, the data literate person also understands what can and can't be done with them in analysis and visualization.

# Data Types: NOIR



Nominal = "Names"

E.g. Gender, Color

Ordinal = has order,  
but differences  
between levels is  
unknown

E.g. Satisfaction  
score, level of pain

Interval – has order,  
differences between  
values is consistent,  
but 0 does not  
mean “none”

E.g. Temperature in  
°F

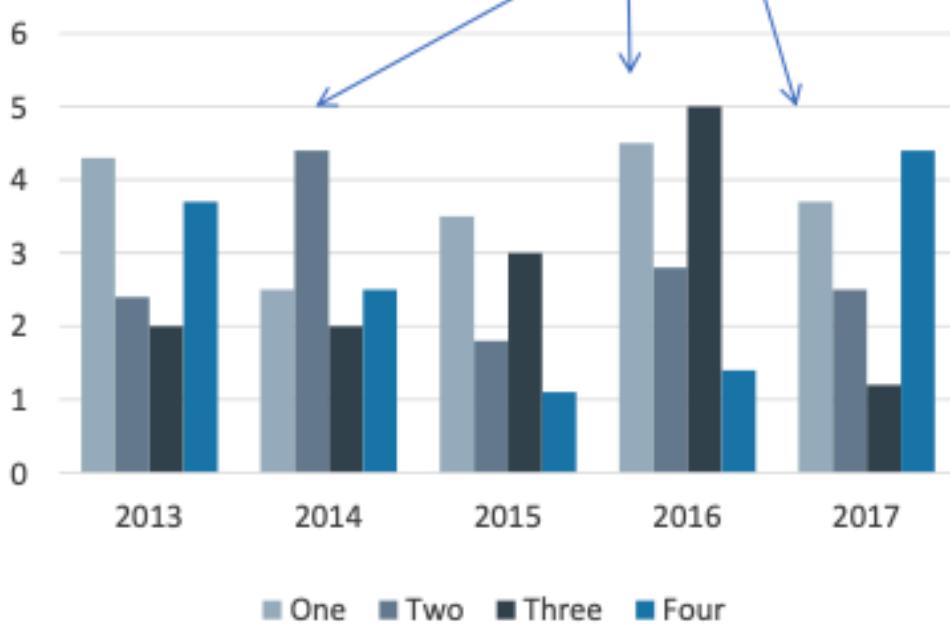
Ratio – has order,  
differences between  
values is consistent,  
and 0 means “none”

E.g. Height of  
people in the room

# Why does data type matter?

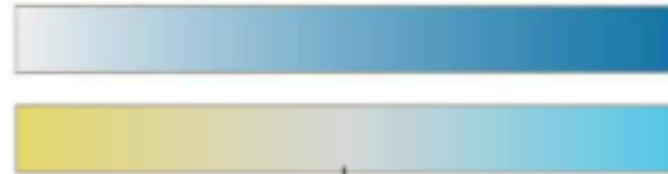
Quantitative variables make axes

Categorical variables make “buckets” or headers



Quantitative variables make...

sequential  
and  
diverging



color palettes with varying saturation

Categorical variables make colors with different hues





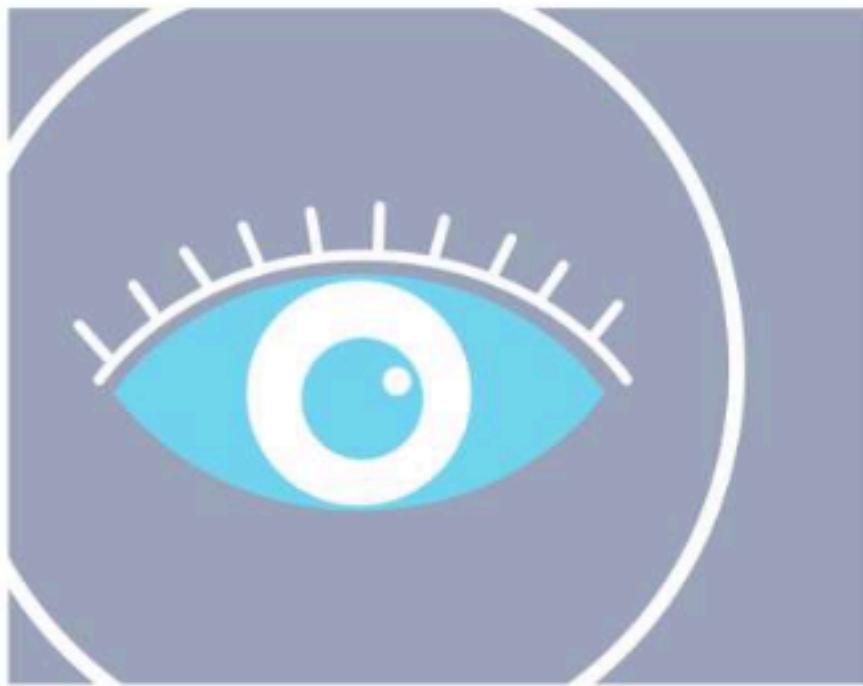
## DATA STORAGE METHODS

The data literate person is familiar with ways that data is collected, structured and stored, and the attributes associated with each approach. Spreadsheets with their cells in rows and columns are seen as distinct from databases with their records arranged in relational tables or non-relational documents.



## DATA ANALYSIS PRINCIPLES

Those who are data literate understand that storing data is not an end in and of itself, but rather a means of extracting valuable insight about one's environment. The data literate person must therefore grasp the fundamental principles of analysis and statistics and when they apply.



## DATA VISUALIZATION RULES OF THUMB

Since the human visual system is a “very high bandwidth channel to the brain”<sup>3.1</sup> the data literate person understands various ways to visualize data and their respective pros and cons. The principles of cognition relating to how humans decode visual encodings such as position, length, area, and color, are well known to the data literati, as are the different chart types that make use of these encodings.

## Channels: Expressiveness Types and Effectiveness Ranks

### ④ Magnitude Channels: Ordered Attributes

Position on common scale 

Position on unaligned scale 

Length (1D size) 

Tilt/angle 

Area (2D size) 

Depth (3D position) 

Color luminance 

Color saturation 

Curvature 

Volume (3D size) 

### ⑤ Identity Channels: Categorical Attributes

Spatial region 

Color hue 

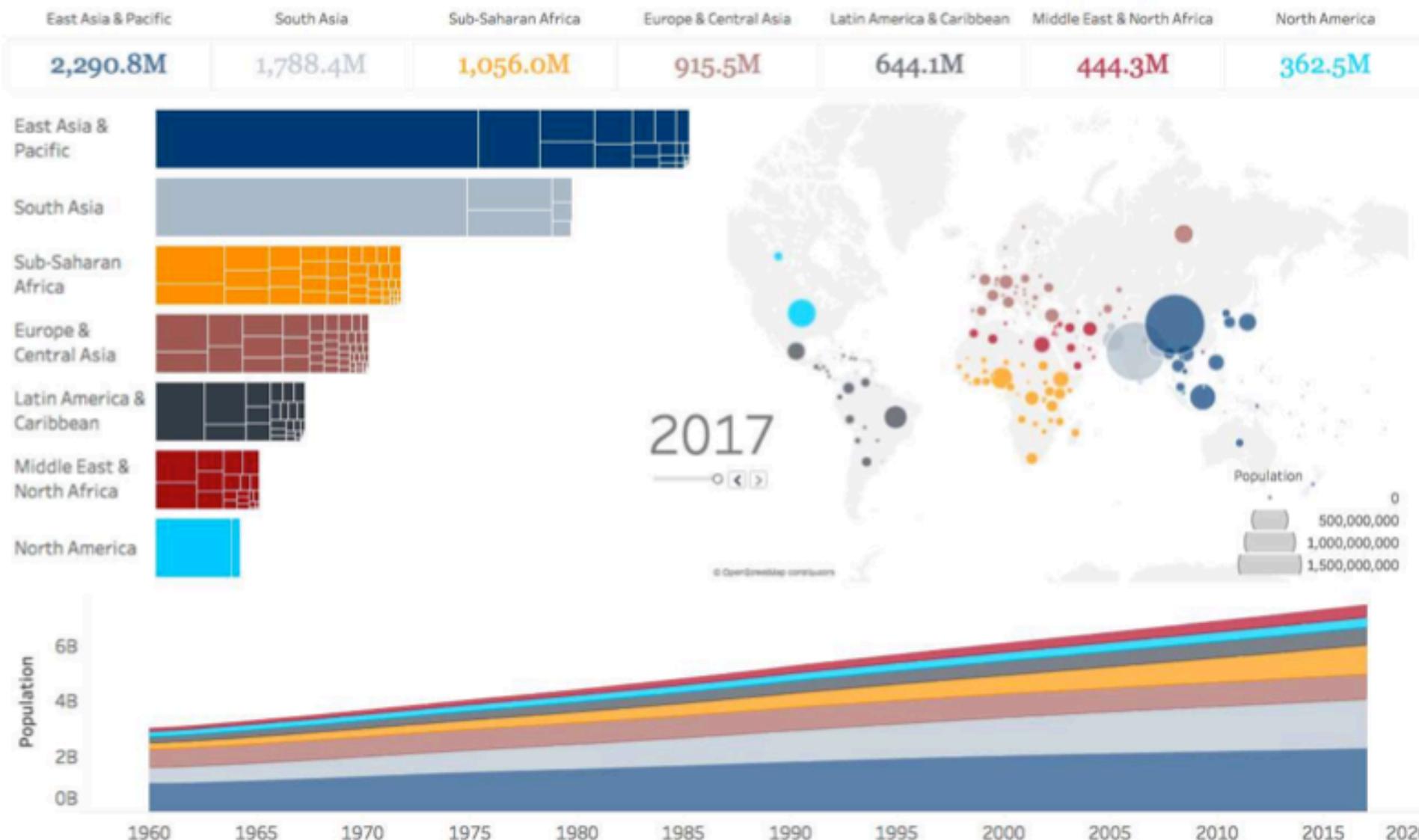
Motion 

Shape 

▲ Most  
Effectiveness  
▼ Least  
Effectiveness  
Same

# World Population Growth by Region

7,501,739,318 total population





## PREPARE DATA FOR ANALYSIS

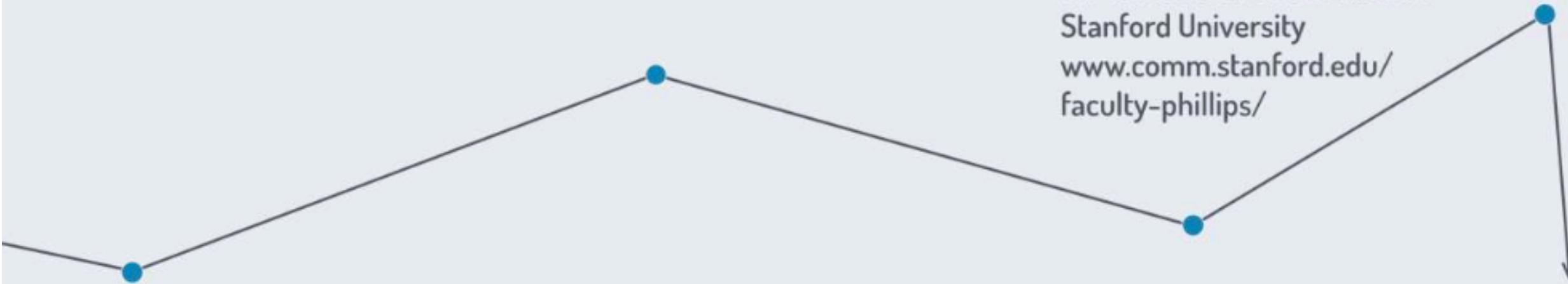
The answers to our questions can rarely be answered by one single, clean data set. Data is most often 'dirty' - full of errors and formatting issues - and relevant information is often stored in multiple places. For this reason, people who are data literate know how to clean dirty data and combine multiple data sets together for analysis.

“ Anyone who has worked with data knows that it doesn't all come in pristine form. For this reason, a data literate person needs to learn how to handle data that needs some work, or that doesn't even exist in a data form and needs to be gathered. This is often missed, but it's one of the key points in becoming data literate.”



## CHERYL PHILLIPS

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Who needs spell check, anyway?

Volkswagen

Voldswagen  
VOLKSWAGEN SW

Volswagon

Volkswag  
Volkswage  
Volksqagon  
Volkwagen  
Volskwagen  
Volkswago  
Volksawen  
Volks VOLKS

VOLKSWAGEN

Volkeswagon  
VOLKSWAGEN CONV  
Volkswaqqon  
Volkswage N

VOLKSWAGON Volks Wagen Volkswagen Voltswagen  
Volkwagon Volts Wagon  
VOLKWAGEN Volkswagen Voikswagen  
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VOLKSWGEN

Volkswagen

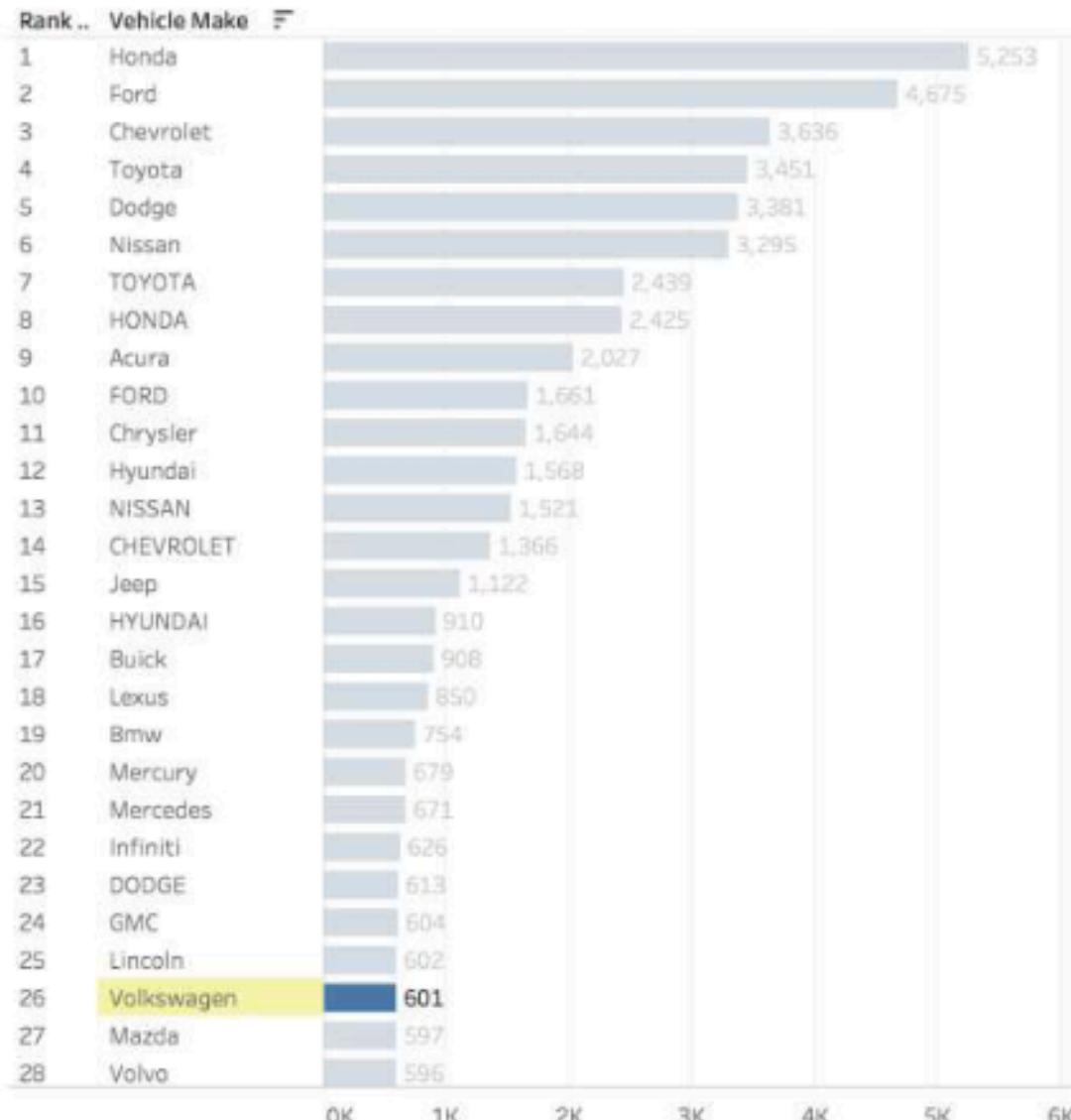
Volkswasgen Volksawagon  
Volztwagen

VBOLKSWAGEN Volkeswagen

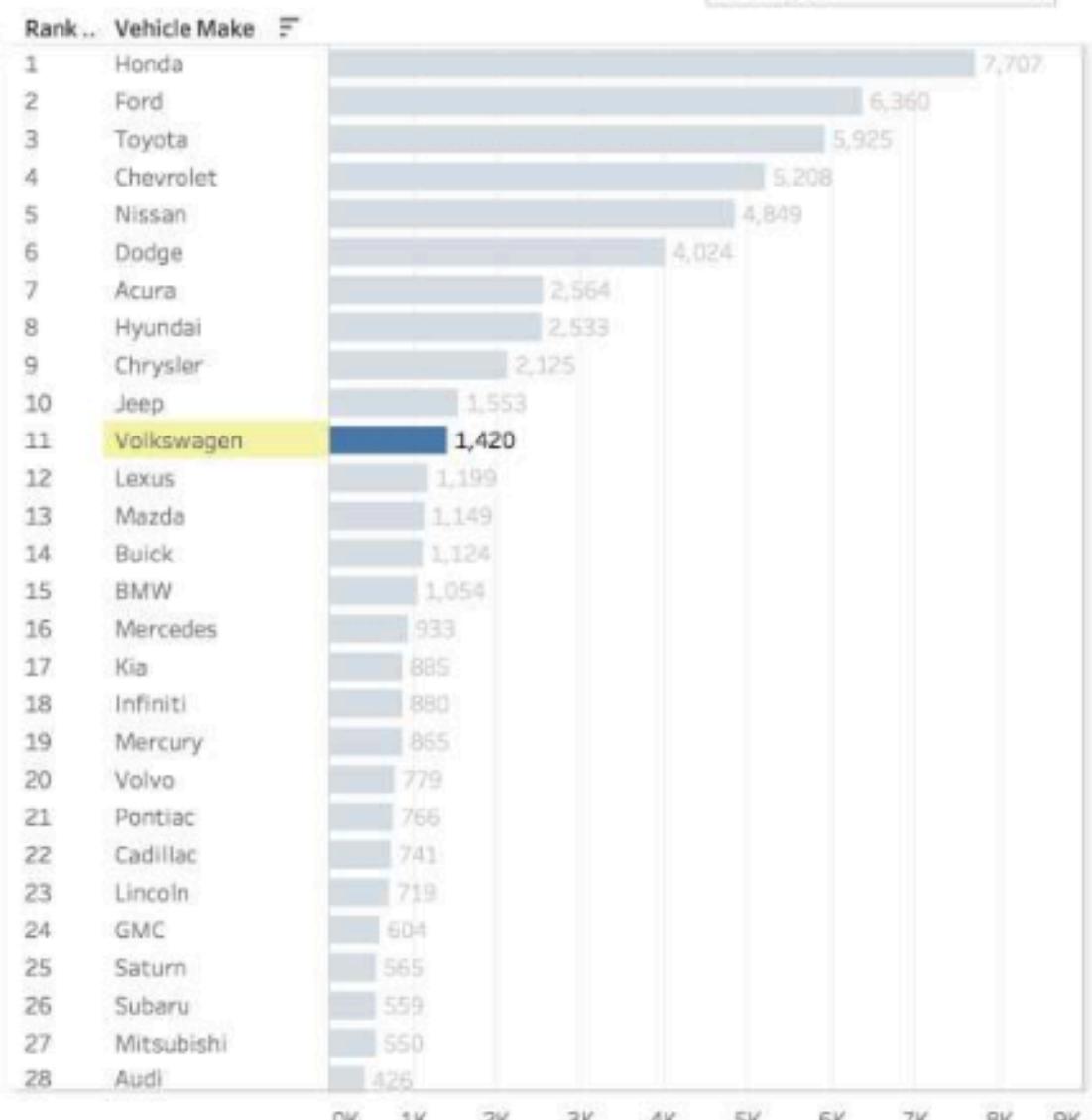
VOLKSWAGEN SW

# What was the effect of the grouping?

Vehicle Makes - Original



Vehicle Makes - Cleaned





## COMMUNICATE DATA EFFECTIVELY

Data literate people know that the true power of data is in shaping the minds and directing the decisions of their fellow human beings. For this reason, they know how to communicate effectively using data and information gleaned from it. Put another way, they speak data well.



## ETHICAL

Data can be used to help or to harm, and data literate people consider ethical use of data and the impact on society to be of utmost importance. Data literate people find ways to use data to help their organizations grow, but they only do so while respecting the rights and privacy of others and while seeking to improve the lives of those affected.

PRINCIPLES



## As data teams, we aim to...

1. Use data to improve life for our users, customers, organizations, and communities.
2. Create reproducible and extensible work.
3. Build teams with diverse ideas, backgrounds, and strengths.
4. Prioritize the continuous collection and availability of discussions and metadata.
5. Clearly identify the questions and objectives that drive each project and use to guide both planning and refinement.
6. Be open to changing our methods and conclusions in response to new knowledge.
7. Recognize and mitigate bias in ourselves and in the data we use.
8. Present our work in ways that empower others to make better-informed decisions.
9. Consider carefully the ethical implications of choices we make when using data, and the impacts of our work on individuals and society.
10. Respect and invite fair criticism while promoting the identification and open discussion of errors, risks, and unintended consequences of our work.
11. Protect the privacy and security of individuals represented in our data.
12. Help others to understand the most useful and appropriate applications of data to solve real-world problems.

# Ethics and Data Science



Mike Loukides,  
Hilary Mason  
& DJ Patil

## Ethics and Data Science

by DJ Patil, Hilary Mason, Mike Loukides

### The 5 C's:

- Consent
- Clarity
- Consistence and Trust
- Control and Transparency
- Consequences

### Princeton Case Studies:

Automated healthcare app, Dynamic sound identification,  
Optimizing schools, Law Enforcement ChatBots, Hiring by  
machine, Public sector data analytics

<https://aiethics.princeton.edu/case-studies/>



## UTILIZES DATA RESOURCEFULLY

A data literate person actively seeks out and creates data as a means of gathering information. If data exists that will help them make an important decision or come to a much-needed understanding about the current situation, they can be counted on to find it and make good use of it.



## CONTINUOUSLY IMPROVES DATA

Knowing that analyses and their underlying data are always imperfect and incomplete to some degree, data literate individuals identify areas of improvement in the data and associated analysis. Once identified, they proactively seek to implement improvements as time and resources permit.



## EFFECTIVELY ADVOCATES FOR DATA

Data literate team members advocate for the effective use of data in communication and decision-making. When data is not being utilized in important discussions and decisions, they proactively suggest ways to add a data-driven perspective, and they offer their advice or assistance to make it happen.